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THE INVESTIGATION OF STUDENTS' COGNITIVE AND METACOGNITIVE COMPETENCIES ACCORDING TO DIFFERENT VARIABLES

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Abstract:
The purpose of this study is to examine six sub-dimensions towards motivational, cognitive and metacognitive competencies of middle school students according to the gender and class level variables. As the data collection tool, "Motivational, Cognitive and Metacognitive Competencies Scale" was used. The sample of the research is composed of 366 middle school students and the data were analyzed using SPSS 23. There was a significant relationship between competencies levels and gender in favor of male for the general of scale. Moreover, for the sub-dimensions of the scale according to the gender, a significant relationship in favor of male for organizing the learning process and evaluating the learning process was found. When the motivational, cognitive and metacognitive competencies levels of middle school students were examined separately for each of sub-dimensions, a significant relationship was found according to the grade levels. It was generally observed that students' motivational, cognitive and metacognitive competencies levels increase as their grade levels increase. However, 5th grade students' scores were higher than the other grade students' scores for the learning process sub-dimension.

Keywords: metacognitive competence, cognitive competence, self-sufficiency, middle school students

1. Introduction

Recent years, the teacher-centered teaching approach remains weak in the training of individuals who can adapt to changing conditions in rapid information flow

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(Başboğaoğlu & Demir, 2011; MEB, 2005). Therefore, the training process has shifted from a traditional teacher-centered approach to a student-centered learning-teaching approach (Baki, 2008; Stevens, 1996; Thornburg, 1995). In order to achieve this shift, the education should develop individuals who make the right decisions, produce creative and new ideas, know how to access, distinguish they need to know how much of what, recognize themselves and their learning styles (Umay, 2003). In this respect, it is important to know how students learn a new information and how they construct this new information during the training of students (Andrée, 2003; Demirel, 2011). Because metacognition is one of the theories that enable students establish relationships between the knowledge they possess and the new knowledge and use their own learning and observations in new areas (Victor, 2004), metacognitive competencies can play an important role in the training of students.

Although metacognition is a relatively old concept in learning theory, for the first time, Flavell (1979) defined it as having knowledge of individual's own cognitive processes and using that information to control her cognitive processes. Similarly, Crick (2000) defined the metacognition as being aware of the events and functions of one's own mind. He has also expressed it as a super system, which can be used to direct mental events and functions. In other words, metacognition is the thought about knowing and thinking what we know and what we do not know (Aktamış & Uça, 2010). In this context, metacognition is expressed as an umbrella that surrounds things related to one's own thinking processes and knowledge (Leader, 2008). However, to fully understand the metacognition concept, it is necessary to understand what the cognition concept is (Akpunar, 2011). The metacognition concept can be considered as knowledge of the individual's cognition (Schraw & Moshman, 1995). Cognition is defined as the process of internalization (Weinstein & Mayer, 1986). According to Fidan (1996), cognition is the mental process that human mind has made for the meaning of events in the world and its periphery. The difference between cognition and metacognition can be expressed as follows: Cognition is the information necessary for accomplishing a problem or a task, whereas metacognition is the knowledge required to understand how a problem or a task is accomplished (Schraw, 2001). Akın (2006) stated that the function of cognition as to provide cognitive interventions to solve problems and the function of metacognition as to organize or manage individual's cognitive performance in problem solving. While cognition is concerned with what we done, metacognition deals with choosing what we will do and watching what is done with planning (Schurter, 2001).

Individuals with metacognitive competence can plan a learning process, and control, evaluate and organize themselves according to the learning environment (Schraw, 2009). Similarly, Doğanay (1997) stated that individuals with metacognitive competence are aware of learning processes, control these processes, make plans about their own learning, follow the learning process, organize learning methods, and finally can make self-evaluation that only occurs with effective and sufficient metacognitions. Moreover, Costa (1984) emphasized that students with metacognitive competence can make plans, solve problems, are aware of the strategies used, and use evaluation

processes effectively. Therefore, Gourgey (1998) stated that behaviors such as students asking questions to themselves and self-monitoring are important. In this respect, as Hacker, Dunlosky and Graesser (2009) and Victor (2004) emphasized, metacognition is important in the education of individuals. Thus, in some research, it was stated that there is a meaningful relationship between academic success and metacognitive skills (Bağçeci, Döş & Sarıca, 2011; Case, Harris & Graham, 1992; Cautinho, 2007; Desoete & Roeyers, 2002). In other words, it is seen that advanced students have more success in metacognition skills because students who are equipped with effective metacognitive skills can evaluate their information correctly. In addition, following ongoing learning process, they can update their knowledge and make effective plans for new learning (Everson & Tabias, 1998). On the other hand, students' awareness of the cognitive abilities may indicate that they have knowledge of their own cognition system, its structure, and its working style. Therefore, students can notice what the learning style is by recognizing themselves, and they can organize education and training activities (Duman, 2008). Victor (2004) stated that students can explore problem-solving processes by recognizing their own cognitive abilities and can use these processes in different situations. Thus, it is concluded that studies evaluating students' cognitive and metacognitive competences from different dimensions increase their overall success. Therefore, in this study, these competences are examined within the context of various variables.

As individuals grow older their metacognitive levels rise, but individuals may not have full knowledge of metacognitive skills and competences (Baker, 1989). Therefore, it may be necessary to detect individuals' metacognitive skills and competencies. Students may become aware of their own learning processes and can learn how to control these processes with the detection of metacognitive skills (Thompson, 2007). Students also help on the learning process by reflecting with this detection (Darling-Hammond, Austin, Cheung & Martin, 2003). On the other hand, Gama (2001) stated that students who are aware of their cognitive skills will have more strategic and better performance than students who are not aware of them. Senemoğlu (1997) emphasized that teachers can guide students to acquire metacognitive knowledge and skills. Therefore, the determination of the cognitive and metacognitive competencies of students is an important first step for experimental studies that aim to change and improve the academic achievements and attitudes of students.

When the literature is examined, it is seen that Culaste (2011) tried determining the cognitive levels of sixth-year middle school students in solving mathematics problems. The researcher determined that the metacognitive prediction and assessment skills of the students were low, and also there was a significant difference between the prediction and assessment on cognitive tasks. Adibnia and Putt (1998) also examined how the instruction of metacognitive steps influenced 60 students,' aged between 10 and 12, mathematical problem solving performances. They found that metacognitive approach to problem solving leaded students' cognitive and metacognitive activities and significantly improved their problem solving performances. In a study conducted with eight grade students, Mevarech and Kramarski (2003) found that the development

of mathematical reasoning of students is effected by the instruction on metacognition. When the studies on the research topic are examined in general, it is seen that the researchers focused on students' metacognition and the relation between problem solving skills and mathematical achievements (Baltaci, Yildiz & Özcakir, 2016; Desoete, Roeyers & Buysse, 2002; Kramarski, 2008; Stewart, Cooper & Moulding, 2007), tried to develop metacognition (Küçük-Özcan, 2000; Schoenfeld, 1987; Volet, 1991; Yıldız & Ergin, 2012), and examined the change with experimental study supporting some teaching methods with metacognition (Blank, 2000; Kramarski, Zemira & Arami, 2002). On the other hand, when looking at the studies that tried to determine the metacognitions of the individuals, it was seen that the total scores obtained from the applied scales gave the metacognition levels of students' (Bağçeci, Döş & Sarıca, 2011; Culaste, 2011; Desoete & Royers, 2002; Evran & Yurdabakan, 2013; Koç & Karabağ, 2013; Lucangeli & Cornoldi, 1997). In this study, a scale was developed to determine cognitive and metacognitive levels of middle school students' for the following six sub-dimensions: Self-sufficiency, metacognitive strategies, actual value of learning, the use of learning strategies, organizing learning process, and evaluating learning process. Thus, the purpose of this study was to examine the above mentioned sub-dimensions towards motivational, cognitive and metacognitive competencies of middle school students according to the gender and class level variables. In this context, the following research questions were examined:

1. When the motivational, cognitive, and metacognitive competency levels of middle school students are examined in general and separately for each of the above mentioned sub-dimensions of the scale, do they make a significant difference according to the gender?
2. When the motivational, cognitive, and metacognitive competency levels of middle school students are examined in general and separately for each of the above mentioned sub-dimensions of the scale, do they make a significant difference according to the class levels?

2. Method

In this section, information related to research design, sample, instruments and data analysis were given.

2.1. Research Design

Study was designed to be a quantitative research to reveal cognitive and metacognitive competencies of middle school student. Relationship between students' self-sufficiency, metacognitive strategies, actual value of learning, using the learning strategies, organizing the learning process and evaluating the learning process sub-dimensions and gender - class levels are examined. Therefore, this study was designed as descriptive study and conducted by using relational screening model. Relational screening model are research models that aim to determine the presence or degree of

change between two or more variables (Cohen, Manion & Morrison, 2000; Karasar, 2006).

2.2. Sample

The sample of the research is composed of 366 (202 female, 164 male) middle school students studying in the state schools located in one province of the West Black Sea Region in the academic year of 2016-2017. In the selection of the related schools was used proportional selection method that is one of the probability-based sampling varieties.

Table 1: Distribution of the sample in terms of gender and class levels

		Class				Total
		5th grade	6th grade	7th grade	8th grade	
Gender	Male	58	32	51	23	164
	Female	34	63	36	69	202
Total		92	95	87	92	366

2.3. Instruments

As the data collection tool, "Motivational, Cognitive and Metacognitive Competencies Scale (MCMCS)" adapted from English to Turkish by Aktamış and Uca (2010) was used. The sub-dimensions of MCMCS consisting of 26 items are "Self-sufficiency", "Metacognitive strategies", "Actual value of learning", "Using the learning strategies", "Organizing the learning process" and "Evaluating the learning process". Each item of the scale included "never agree ", "disagree", "undecided", "agree" and "completely agree", and it was rated from 1 to 5. The lowest score to be taken from the scale is 26, while the highest score is 130. The low scores indicate low of motivational, cognitive and metacognitive competence levels, and high scores indicate high of these levels. Moreover, in this study, for each sub-dimension, the total scores were calculated and the results were analyzed according to the gender and class levels.

2.4. Data Analysis

In the analysis process, firstly, using LISREL 8.80 (Linear Structural Relations 8.80) package program, confirmatory factor analysis was performed to evaluate the validity of the sub-dimension construction emerging as a result of exploratory factor analysis conducted in the during the developed of Motivational, Cognitive and Metacognitive Competencies Scale. As a result of the analysis, the χ^2/df value was found to be 2.08. Bollen (1989) suggests that this value should be between 0 and 5. Moreover, RMSE and SRMR values was found to be .054 and .075 respectively. These values indicate acceptable data compatibility (Browne & Cudeck, 1993). On the other hand, CFI value was found to be .94 and it is recommended that this value should be .90 and higher (Hu & Bentler, 1999). As a result, it is seen that the items are gathered in six factors and each item has a good representation as stated by researchers who developed the scale. Next, it was examined whether the data were appropriate for normal distribution, or not, and

the skewness and kurtosis coefficients was found to be -.50 and -.02 respectively. The fact that these values do not significantly differ from the range of -1 to +1 indicates that the distribution is normal (Mertler & Vannatta, 2005). On the other hand, the distribution graphs were also examined and it was determined as appropriate to normal distribution. Moreover, the homogeneity of the variances was examined by the Levene Test and the data were analyzed with SPSS 23 (Statistical Package for the Social Sciences 23) program using parametric statistics. Independent-samples T test was conducted to determine the relationship between students' genders and sub-dimensions. One-way analysis of variances (One-Way ANOVA) was conducted to determine the relationship between students' class levels and sub-dimensions. Moreover, the Cronbach alpha internal consistency coefficient of the scale was calculated as .859.

3. Results

In this section, motivational, cognitive and metacognitive competencies levels of middle school students were examined separately for each of the above mentioned sub-dimensions and general of the scale, and also it was investigated whether there are relationships according to the gender and grade levels. When middle school students' motivational, cognitive and metacognitive competencies levels were compared with gender by taking the total score for the general of the scale, the results in Table 2 were found.

Table 2: The relationship between motivational, cognitive and metacognitive competencies levels and gender

	Gender	N	$\bar{X}$	Sd	t	p
Motivational, cognitive and metacognitive competencies levels	Female	202	107.00	11.44	2.81	.006
	Male	164	109.91	8.31		

The lowest score to be taken from the MCMCS is 26; the highest score is 130. Whether there was a significant difference between the total score of the scale and students' gender, was analyzed by using the independent-samples T test. According to the results, it was seen that significant difference was between motivational, cognitive and metacognitive competencies levels and gender due to p=.006<.05. It was observed that male students' motivational, cognitive and metacognitive competencies levels were higher than female students. When the gender was examined separately for each sub-dimension of the scale, the results in Table 3 was obtained.

Table 3: The relationship between each sub-dimension of the scale and gender

	Gender	$\bar{X}$	Sd	t	p
Self-sufficiency	Female	21.19	2.61	.236	.814
	Male	21.25	2.01		
Actual value of learning	Female	9.06	1.25	1.67	.096
	Male	9.26	.952		
Metacognitive strategies	Female	16.04	2.49	.456	.649
	Male	16.15	1.77		
Using the learning strategies	Female	20.39	3.13	.402	.688
	Male	20.51	2.58		
Organizing the learning process	Female	15.83	2.41	2.04	.042
	Male	16.32	2.08		
Evaluating the learning process	Female	24.48	4.29	4.82	.000
	Male	26.43	3.45		

As seen on Table 3, there was no significant relationship between self-sufficiency and gender due to p=.814>.05. On the other hand, the lowest score for the self-sufficiency sub-dimension is 5; the highest score is 25, and it was identified as the self-sufficiency levels of both genders were quite high. Moreover, there was no significant relationship between actual value of learning sub-dimension and gender (p=.096>.05). The lowest score to be taken from the scale for actual value of learning sub-dimension is 2; the highest score is 10. It was also seen that the levels of this sub-dimension for both genders are very high.

As seen on Table 3, there was no significant relationship the relationship between metacognitive strategies sub-dimension and gender (p=.649>.05). It can be said that the metacognitive strategies sub-dimension levels for both genders are good, because the lowest score to be taken from the scale for the metacognitive strategies sub-dimension is 4; highest score is 20. In addition, it was determined that there was no significant relationship between using the learning strategies sub-dimension and gender (p=.688>.05). On the other hand, it was observed that there was significant difference between organizing the learning process and gender (p=.042<.05), and between evaluating the learning process and gender (p=.000<.05). For both sub-dimensions, this difference is favored by male students.

On the other hand, the following results were obtained, when the relationship between general of the MCMCS and grade levels were examined for middle school students. Then, ANOVA results were presented in Table 4.

Table 4: The relationship between motivational, cognitive and metacognitive competencies levels and grade levels

	Grade	N	$\bar{X}$	Sd	F	Difference	p
Motivational, cognitive and metacognitive competencies levels	5	92	103.36	10.77	16.95	5-7	.000
	6	95	106.72	9.16		5-8	
	7	87	110.64	9.33		6-7	
	8	92	112.67	9.19		6-8	

As seen on Table 4, there was a significant difference between motivational, cognitive and metacognitive competencies levels and grade levels due to p=.000<.05. As a result of the Levene test, p=.993>.05 was found and it was seen that the variances were homogeneous. Then, by using the Tukey HSD post-hoc test, it was determined which grade levels these differences were between. While there was no significant difference between the 5th and 6th grades and also 7th and 8th grades, it was seen that there was a significant difference between the others grade levels. Moreover, it was observed that students' motivational, cognitive and metacognitive competencies levels increase as their grade levels increase.

The following results were obtained when examined the relationships between the grade levels and each sub-dimension of the scale.

Table 5: The relationship between each sub-dimension of the scale and grade levels

	Grade	N	$\bar{X}$	Sd	F	Difference	p
Self-sufficiency	5	92	20.18	2.48	11.89	5-7 5-8 6-8	.000
	6	95	21.08	2.41			
	7	87	21.51	2.28			
	8	92	22.12	1.80			
Actual value of learning	5	92	8.79	1.16	4.92	5-7 5-8	.002
	6	95	9.15	1.30			
	7	87	9.36	.99			
	8	92	9.33	.95			
Metacognitive strategies	5	92	14.63	2.17	35.72	5-6 5-7 5-8 6-7 6-8 7-8	.000
	6	95	15.71	1.99			
	7	87	16.63	1.68			
	8	92	17.43	1.87			
Using the learning strategies	5	92	17.43	2.17	119.23	5-6 5-7 5-8 6-7 6-8 7-8	.000
	6	95	19.91	2.11			
	7	87	21.66	2.18			
	8	92	22.85	1.77			
Organizing the learning process	5	92	15.32	2.20	10.71	5-8 6-8 7-8	.000
	6	95	15.82	2.08			
	7	87	15.98	2.45			
	8	92	17.09	2.02			
Evaluating the learning process	5	92	27.00	3.58	10.24	5-6 5-7 5-8 7-8	.000
	6	95	25.05	3.49			
	7	87	25.52	3.68			
	8	92	23.86	4.71			

According to Table 5, there was a significant difference relationship between self-sufficiency and grade levels (p=.000<.05). Then, the post-hoc test has been introduced to determine which grade levels these differences are between. As a result of the Levene

test, it was seen the homogeneity of the variances due to p=.067>.05, and so Tukey HSD post-hoc test was used. According to analysis results in Table 5, these differences were between the 5th and 7th grades, 5th and 8th grades and also 6th and 8th grades. In addition, 5th grade students' self-sufficiency levels were lower than students in the other grade.

As seen on Table 5, there was a significant difference between actual value of learning sub-dimension and students' grade levels due to p=.002<.05. As a result of the Levene test, p value was found as .565 and it was seen the homogeneity of the variances, because this value was higher than .05. Thus, it was seen that a significant difference between 5th and 7th grades and 5th and 8th grades according to the Tukey HSD post-hoc test. 5th grade students' actual value of learning levels was lower than students in the other grade levels.

It was seen that there was a significant difference between metacognitive strategies and grade levels due to p=.000<.05. According to the Levene test, it was found as p=.499>.05 and so the homogeneity of the variances was provided. As a result of the Tukey HSD post-hoc test, it was found that this difference was between all grade levels. Moreover, while the metacognitive strategies levels were the lowest for 5th grade students, it was the highest for 8th grade students.

According to Table 5, there was a significant difference between using the learning strategies and grade levels due to p=.000<.05. As a result of the Levene test, it was found as p=.663>.05 and it was seen the homogeneity of the variances. There was a significant difference between all grade levels according to the Tukey HSD post-hoc test. Moreover, in this sub-dimension, while 5th grade students' levels were the lowest, highest levels were found for 8th grade students.

There was a significant difference between organizing the learning process and grade levels (p=.000<.05). As a result of Levene test, it was seen homogeneity of the variances due to p=.221>.05. Then, by using the Tukey HSD post-hoc test, it was determined which grade levels these differences were between. According to the analysis results, a significant difference between 8th grade and the other grade levels was found. Moreover, it was observed that 8th grade students' organizing the learning process levels were higher than the other grade students.

As seen on Table 5, there was a significant difference between evaluation the learning process and grade levels (p=.000<.05). As a result of the Levene test, p value was found as .005, and so it was observed that the variances were not homogeneous, because this value was lower than .05. It was obtained a significant difference between 5th grade students and the other grade students by using the Games-Howell post-hoc test. Moreover, a significant difference between 7th and 8th grade students was found. On the other hand, 5th grade students' scores were higher than the other grade students' scores for this sub-dimension.

4. Discussion

In this study, middle school students' motivational, cognitive and metacognitive competencies were examined, and the related scale's sub-dimensions such as self-

sufficiency, metacognitive strategies, actual value of learning, using the learning strategies, organizing the learning process and evaluating the learning process were investigated according to the gender and grade levels. There was a significant relationship between competencies levels and gender in favor of male for the general of scale. Similarly, it was seen that a significant difference between metacognitive competencies and the gender was emerged in some studies (Alcı & Altun, 2007; Kana, 2015; Miller, 2000; Peklaj & Pecjak, 2002). However, in these studies, researchers were found that the female students' metacognitive competencies levels were higher than that of male students. As it is also here, differences arising according to the gender in these types of studies may be due to biological factors such as hormonal functions and brain structures, or social factors such as the environment, social values and culture (Bucko, 1997). These variables may have led to the differences in levels of the cognitive and metacognitive competence in the learning process because the variables constitute the basis of individual differences. In this respect, teachers shape their teaching by taking into account these variables in the teaching process, and so motivational, cognitive and metacognitive competencies between females and males can be balanced thanks to the shaping of their teaching.

When examined in terms of the sub-dimensions of the scale according to the gender, a significant relationship in favor of male for organizing the learning process and evaluating the learning process was found. In the literature, it was seen that there was either a significant relationship in favor of female (Miller, 2000; Peclak & Pecjak, 2002) or no significant relationship for both (Lee & Browman, 2001). On the other hand, in the study of Bagceci, Dos and Sarica (2011) was expressed that there was a significant difference in favor of female for the evaluating the learning process. However, in this study, it was observed that there was no significant relationship between the other sub-dimensions and gender. Moreover, when looked at some studies in the literature, it was seen that there was no significant between metacognitive and gender (Dilci & Kaya, 2012; Özsoy, Çakıroğlu & Kuruyer, 2010; Özsoy & Günindi, 2011), as well as a significant in favor of the females (Baykara, 2011; Demir & Özmen; 2011). Similarly, it was possible to see some studies that there was either a significant relationship in favor of males between self-sufficiency and gender (Pajares & Miller, 1994; Schnulz, 2005) or no significant relationship for both (Doğan, Beyaztaş, Koçak, 2012; Goodwin, Ostrom & Scott, 2009; Özsüer, İnal, Uyanık & Ergün, 2011).

When the motivational, cognitive and metacognitive competencies levels of middle school students were examined separately for each of sub-dimensions, a significant relationship was found according to the grade levels. It was generally observed that students' motivational, cognitive and metacognitive competencies levels increase as their grade levels increase. Indeed, it was emphasized that higher-level students have higher metacognitive competencies (Hanten et al., 2004; Schneider, 2008; Zimmerman & Martinez-Pons, 1990). However, a remarkable finding was that when examining the total scores in the evaluating the learning process sub-dimension, it was observed that the lower score is as the grade level gets higher. For this sub-dimension, 5th grade students' average was higher than the other grade levels. In the evaluation

process, there was a judgment the response itself and process leading to this response (Desoete, 2001). However, as noted in some studies, due to the fact that the transactional skill increases with age (Aunıo, Hautamäkı, Heıskarı, & Luit, 2006; Gürbüz & Birgin, 2008) may have led to the tendency to terminate the process without the need for the evaluation process of the students. In addition, the use of traditional methods in the training of students may led to such a result (Moseley, 2005). Therefore, teachers should give opportunities to students in order to evaluate their own processes during the course. Thus, such problems might disappear.

It is said that the study is original when the related literature is examined, because thanks to the scale used in this study, levels of middle school students for six sub-dimensions: self-sufficiency, metacognitive strategies, actual value of learning, using the learning strategies, organizing the learning process and evaluating the learning process may be revealed separately. Therefore, a similar study can be done with preservice teachers. Moreover, each sub-dimension can be compared with different variables. Because cognitive and metacognitive competencies that will be brought to the preservice teachers will make them qualified individuals while creating the future, and so teachers will have an important role to play in the training of individuals who meet the needs of the age in the formation of the future.

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